DRAFT

GOES

ADVANCED BASELINE IMAGER (ABI)

INTERFACE REQUIREMENTS DOCUMENT (IRD)

For Spacecraft Accommodation Studies

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GODDARD SPACE FLIGHT CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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ABI Interface Requirements Document

1.0 SCOPE

1.1 Introduction

The purpose of this Interface Requirements Document (IRD) is two-fold. The first is to establish a baseline for interface requirements between GOES spacecraft and the ABI. Second, it serves as a core building block on which the instrument-to-spacecraft interface can be designed. The spacecraft integrating contractor and the instrument contractors **shall** each meet their respective interface requirements as defined in this document.

This IRD does not include much of the detailed information that will eventually be in an Interface Control Document (ICD). It only includes information that may be important in conducting a formulation study and will be significantly upgraded for, during and after the implementation phase work. The details of power, telemetry and command interfaces will generally not drive the design of the ABI but some information is included for the trade study. The thermal interfaces and mechanical disturbances that may significantly affect the ABI design are described in more detail.

The spacecraft-to-instrument interface requirements are broken down into four primary groups: mechanical, power, data, and thermal. In addition, environmental testing, contamination, launch and environment requirements are discussed.

This document will be updated during the formulation phase is to provide the basic interface requirements between the ABI, which will be developed first and a spacecraft that will be developed later. The Government will be the system integrator until a system performance responsibility contractor or spacecraft contractor with that responsibility is selected. Until that time, the government will be responsible for accommodation trades, resource allocation (weight, power, space, bandwidth, etc.), and resolving interface issues. This IRD will be converted into an Interface Control Document (ICD) as a joint activity of the instrument and spacecraft contractors. After the ICD is signed and approved by all parties, the ICD will be maintained by the spacecraft contractor.

The ABI Performance and Operations Document (PORD) establishes the allocation of the system requirements to the ABI and defines the instrument requirements.

After award of the spacecraft integration contract, the instrument developer and the integrating contractor **shall** jointly write an Interface Control Document (ICD) which defines the details of the instrument-to-spacecraft interface and related information.

1.2 GOES System Overview

NOAA currently operates and maintains a geosynchronous earth observing system, which nominally has two operational spacecraft in orbit, GOES-East and GOES-West. A good overview of the existing (GOES 8, 9 and 10) systems can be found in the Proceedings of SPIE - The International Society for Optical Engineering Volume 2812, 7-9 August l996, "GOES-8 and Beyond" and in Section 4 - GOES in SPIE Volume 3439, 19-21 July 1998. It should be noted the new series of GOES spacecraft N -Q are being developed by Hughes Spacecraft Corp. and have some significant differences in the details of the design and implementation from that described in some of the references. The spacecraft to carry the ABI (and the Advanced Baseline Sounder) will likely have some significant differences from the GOES N series of spacecraft.

NOAA will provide and operate the Command and Data Acquisition (CDA) facility which receives the data from the GOES and a Satellite Operations and Control Center (SOCC) which operates the spacecraft and processes the data for distribution to the users. The Government will provide the ABI Ground System (ABI-GS) that will calibrate, navigate and process the ABI data for distribution to the users.

This IRD describes the emission limits that must be met by the ABI because the GOES spacecraft has extensive RF communication requirements. Two that may have a significant impact on the design of the ABI are: (1) a Data Collection System that receives signals from small environmental platforms on the Earth’s surface at rates up to few thousand bits/second in the frequency range of 401.9 to 402.2 megahertz and (2) a Search and Rescue transponder that receives even weaker signals at 400 bits/second in the frequency range of 406.05 to 406.025 megahertz.

1.3 DOCUMENT OVERVIEW

This document contains all interface requirements for the instrument except those labeled “(TBD)”, “(TBS)”, and “(TBR)”. The term “(TBD)” applied to a missing requirement means that the contractor should determine the missing requirement in coordination with the government. The term “(TBS)” means that the government will supply the missing information in the course of the contract. The term “(TBR)” means that the requirement is subject to review for appropriateness by the contractor or the government. The government may change “(TBR)” requirements in the course of the contract.

1.3.1 Conflicts

In the event of conflict between the referenced documents and the contents of this IRD, the contents of the IRD shall be the superseding requirements.

In the event of conflict between the IRD and the PORD the contents of the PORD shall be the superseding requirements.

In the event of a conflict involving the external interface requirements, or in the event of any other unresolved conflict, the NASA contracting officer shall determine the order of precedence.

1.3.2 Requirement Weighting Factors

The requirements stated in this specification are not of equal importance or weight. The following three paragraphs define the weighting factors incorporated in this specification.

- ? **Shall** designates the most important weighting level; that is, mandatory. Any deviations from these contractually imposed mandatory requirements require the approval of the contracting officer.
- ? Should designates an intermediate weighting that indicates the requirements requested by the government are not mandatory. These are goal requirements that would greatly enhance the utility of the data if they were met. Unless required by other contract provisions, noncompliance with the should requirements does not require approval of the contracting officer, but shall require documented technical substantiation
- ? *Will* designates the lowest weighting level. These *will* requirements designate the intent of the government and are often stated as examples of acceptable designs, items, and practices. Unless required by other contract provisions, noncompliance with the *will* requirements does not require approval of the contracting officer and does not require documented technical substantiation.

2.0 APPLICABLE DOCUMENTS

The following documents of the exact issue shown form a part of this IRD to the extent specified herein. In the event of conflict between the documents referenced and the contents of this IRD, the latter **shall** be the superseding requirement.

2.1 Applicable Documents

CCSDS 203.0-B-1 January 87	CCSDS Recommendations for Space Data System Standards. Telecommand, Part 3: Data Management Service, Architectural Definition, Issue 1
CCSDS 701.0-B-2 November 1992	Consultative Committee for Space Data Systems (CCSDS) Recommendations for Advanced Orbiting Systems (AOS), Networks and Data Links: Architectural Specification
CCSDS 102.0-B4 November 1995	CCSDS Packet Telemetry Blue Book, Issue 4
MIL-STD1553B	Digital Time Division Command/Response Multiplex Data Bus
MIL-STD-1541A	Electromagnetic Compatibility Requirements for Space Systems
IEEE 1394-1995	IEEE Standard for a High Performance Serial Bus
S-415-201	GOES Advanced Baseline Imager- Performance and Operation Requirements Document
MIL-STD-461-E	Requirements For the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment
MIL-STD-882c January 93	System Safety Program Requirements
TBD	Geosynchronous Spacecraft & Instrument charging and ESD

NPOESS SRD	NPOESS Common Section of the Sensor Requirements Document
MIL-STD-463A	Definitions and System of Units, Electromagnetic Interface and Electromagnetic Compatibility Technology (Ref) Contamination Control
MIL-STD-1547A December 92	Electronic Parts, Materials, and Processes for Spacecraft and Launch Vehicles
IEEE-1355-1995	IEEE Standard for Heterogeneous Interconnect (HIC) (low-cost, low-latency, scalable serial interconnect for parallel system construction)
UoD-DICE-TN-9201	ECSS-E-50-12 Space Engineering, Spacewire: Links, Nodes, Routers and Networks, Issue E, September 2000 www.estec.esa.nl/tech/spacewire
GSFC X-900-97-004	Charged Particle Radiation Exposure of Geostationary Orbits (Stassinipoulos, Barth, and Nakamura 1997)
MIL-B-5087	Bonding, Electrical, and Lighting Protection for Aerospace Systems
FED-STD-209E	Airborne Particulate Cleanliness in Clean rooms and Clean Zones

3.0 ABI Interface Requirements

3.1 General

The values specified in the IRD are one sigma unless specified otherwise.

3.1.1 Configuration

The ABI is an eight (to 12) spectral channel, two axis scanning (or stepping) radiometer designed to provide variable area imagery and radiometric information of the Earth's surface, atmosphere and cloud cover. The ABI collects data on a three-axis body stabilized satellite in geosynchronous orbit. Capability for star sensing by the ABI is required. The ABI is designed to measure emitted and solar reflected radiance simultaneously in all spectral channels. Data availability, radiometric quality, simultaneous data collection, coverage rates, scan flexibility, and minimizing data loss due to the sun are prime requirements of the system. The ABI requires primary power and decoded command input data from the spacecraft. ABI output data contains instrument information and other data.

The ABI may consist of multiple modules. The present GOES Imager consists of three separate modules, the sensor, electronics and power modules. The sensor module contains the optical system, scanner, detectors and their cooling systems and directly related electronics. The electronics module and power supply module contains power, command, control, and data processing circuitry. The ABI sensor module **shall** be mounted external to the spacecraft body; an electronics module and/or a power supply module if required by the ABI may be mounted either external or internal to the spacecraft body.

3.1.2 Mass, Power, Volume

The following information on mass, power and volume represent the characteristics of the Imager for the GOES-Q mission. They are presented for information and should be considered "goals" until further refined early in the formulation study.

The total ABI mass should be no more than 125 Kilograms (TBR) including all associated electronics, cabling and power supplies.

The ABI should consume no more than 255 (TBR) watts under all operating conditions. The ABI should consume no power (TBR) in Launch Mode, minimal power (TBR) in Instrument Off Mode, moderate power (TBR) in Safe Hold Mode and nominal power in the Instrument Diagnostic and Operational modes. See paragraph 3.4.3.

The ABI components' dimensions, in the stowed and operational configurations (not including any required kinematic mounts), mass and power should be no more than listed in the following table (TBD). Paragraph 3.2.3.4 has more information on deployable covers.

Table 3.1.2-1 ABI components Size, Mass and Power (TBD)

Component	Width	Height	Depth	Mass	Power
ABI Sensor	117.2 cm	77.4 cm	81.5 cm	90 kg	135 W
ABI Electronics	43.2 cm	20.4 cm	67.5 cm	30 kg	90 W
ABI power supply	24.1 cm	17.6 cm	28.3 cm	5 kg	30 W

3.1.3 Instrument Reference Coordinate Frame

A right-hand, orthogonal, body-fixed XYZ coordinate system for the spacecraft **shall** be used. The +Z-axis is downward towards nadir, the Y-axis is approximately along the orbit normal (+Y is opposite the orbital angular momentum) and the X-axis is along the spacecraft velocity vector (+X toward the direction of spacecraft travel). The X-axis and Y-axis reverse directions relative to the orbit with the yaw flip. Roll, Pitch and Yaw are rotations around the X, Y and Z axes respectively.

3.1.4 Dimension Unit Standard

All documents **shall** provide units in metric as the minimum, with English units added for clarification, as an option. All interfaces **shall** be specified in the international system of units, Systém International (SI). Dimensioning **shall** be in the as-designed units. Large angles **shall** be in decimal degrees small angles **shall** be in microradians.

3.1.5 Nominal Orbital parameters

The ABI will be in a geosynchronous orbit. The GOES spacecraft will have a maximum inclination of ?0.5 degrees, be no more than 0.5 degrees from the desired (fixed grid) longitude and have a maximum eccentricity of 0.0012. The nominal longitude locations are 75° and 135° west longitude.

3.1.6 Launch Vehicle Compatibility

The ABI **shall** be compatible with an expendable launch vehicle. Orientation of the ABI modules at launch **shall** be such that the launch loads applied to each axis do not exceed the allowable levels.

3.2 Mechanical

3.2.1 Mass Properties

The mass of the instrument and modules **shall** be measured to +/-0.l kg.

3.2.1.1 Moment of Inertia

The moments of inertia **shall** be calculated for two mission configurations. These include the "stowed" configuration, in which the sensor module covers are closed, and the "deployed" configuration, in which the sensor module covers are open. Moments of inertia values **shall** be accurate to within ? 10% (**TBR**)

3.2.1.2 Center of Gravity

The nominal center of gravity locations for the modules **shall** be provided to spacecraft contractor. The launch and on-orbit center of mass of each instrument and module **shall** be measured and reported to ? 0.5 cm.

3.2.2 Mounting and Alignment

3.2.2.1 Sensor Module

Sensor module should be mounted using kinematic mounts unless the instrument provider demonstrates that kinematic mounts are not required. Mounting requirements **shall** be documented in the ICD.

The ABI **shall** have an alignment cube visible from two orthogonal directions provided by the instrument contractor to enable the alignment of the sensor assembly to the satellite.

3.2.2.2 Electronics Module and Power Supply Module

The interfaces among the satellite and the electronics and power supply modules, if used, **shall** be described on their respective interface control drawings. The electronics and power supply modules do not have specific alignment requirements.

3.2.3 Fields of View

3.2.3.1 Optical Port Field of View

The spacecraft design **shall** provide the ABI an unobstructed optical port FOV within a conical 65? half angle of optical nadir (with respect to the edges of the optical port sunshield) to minimize collection of scattered energy.

3.2.3.2 Sunshields

The sensor module design may include sunshields which reduce the amount of solar energy that reaches the instrument during the hot portion of the geosynchronous orbit (nadir local night) during normal operations. These sunshields **shall** fit within the specified sensor module envelope. The optical port sunshield is attached to the instrument's earth-viewing face, shading the optical port, to reduce the amount of direct solar radiation entering the scan cavity. The ABI sunshield **shall** not enter the field of view of the Sounder Instrument which may be mounted near (head to head for GOES-N) to the ABI.

3.2.3.3 Radiant Cooler Field of View

If required by the ABI the spacecraft **shall** provide the ABI with a FOV approximately normal to the orbital plane suitable for mounting a radiant cooler to cool its IR detectors. This FOV **shall** be a minimally obstructed (TBR) hemispherical FOV, pointing to the north in the northern hemisphere winter and to the south in the summer (TBR). The spacecraft **shall** be capable of implementing two 180^{o} yaw flips per year to achieve this orientation. The thermal input onto the radiant cooler surfaces from the spacecraft will be near zero and controlled (TBR).

3.2.3.4 Deployable Covers

If the ABI requires deployable covers to protect sensitive portions of the instrument from contamination or excessive temperatures during launch and transfer into geosynchronous orbit, these covers **shall** be latched when deployed. These covers **shall** not extend beyond the allowable envelope of the ABI when deployed, unless approval is given by the government to do so.

3.2.4 Mechanical Disturbances and Handling

3.2.4.1 Spacecraft-to-Instrument Disturbances

Because the ABI sensor module contains sensitive and precisely aligned optical components, its performance can be greatly affected by mechanical disturbances (both linear and angular) imparted by the spacecraft to the instrument feet. Low frequency angular disturbances below **TBD** Hz rates translate directly into pointing errors if uncompensated via Spacecraft Motion Compensation (SMC) in the sensor or in the ground processing. High frequency angular disturbances above **TBD** Hz and linear disturbances at all frequencies can modulate instrument optical alignment causing artifacts in the image. The instrument **shall** maintain INR requirements in the presence of sinusoidal disturbances generated by the spacecraft. The disturbance environment may simultaneously include up to 4 frequencies below 10Hz and 4 frequencies above 10Hz about the roll, pitch and yaw axes. The sinusoidal amplitudes measured at the ABI mounting interface shall be bounded by the curve in Figure 3.2.4-1 (TBR) for the given frequencies. The sources of these disturbances include (but are not limited to) effects from solar array drives, momentum and reaction wheels, gyros, other payload mechanisms, and spacecraft thermal "snapping". In the current spacecraft the largest amplitude angular disturbance occurs when the current sounder performs a black body calibration. This starts as a linear ramp around the spacecraft roll axis of about 10 microradians per second lasting for about 18 seconds. Real time measurements of this and other low frequency motions are included in the Spacecraft Motion Compensation (SMC) signal that estimates the motion of the spacecraft navigation base relative to its "desired" pointing and is sent to the ABI, along with the Angular Displacement Sensor (ADS) data which cover the higher frequencies disturbances, see 3.5.1.2.9.

The maximum allowable linear acceleration disturbances from the spacecraft to the sensor module mounting panel during orbital operations **shall** be as specified in Table 3.2.4-1 (**TBR)**.

Table 3.2.4-1 Maximum Allowable Sinusoidal Disturbance

Accelerations from Spacecraft to Instrument (RMS), mG (TBR)

Axis	Below 45 Hz	45 to 120 Hz	Above 120 Hz
X	5.0	0.35	1.2
Y	6.4	1.0	1.0
Z	2.3	0.64	1.0

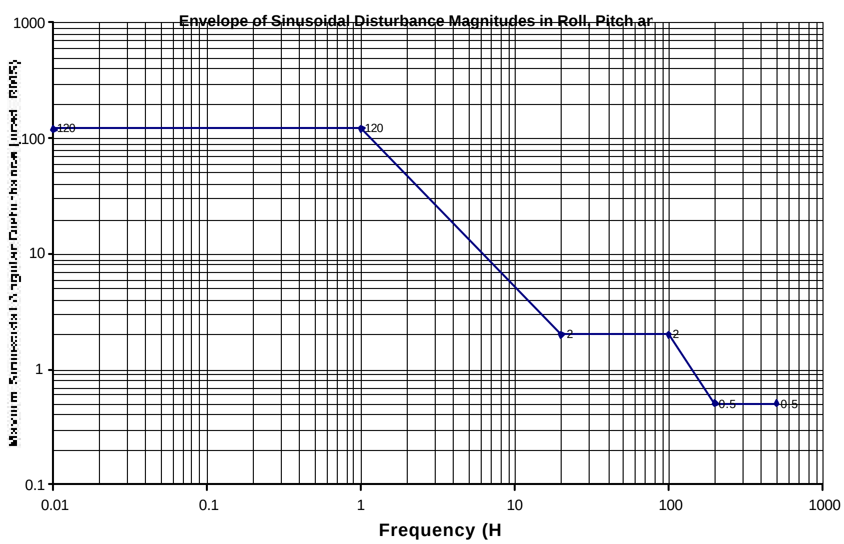


Figure 3.2.4-1 ABI Imager: envelope of Maximum Sinusoidal Disturbances (TBR)

3.2.4.2 Instrument to Spacecraft Disturbances

Due to the dynamic nature of the ABI sensor module during on-orbit operations, the ABI may impart disturbances to the spacecraft. Torque disturbances imparted to the spacecraft originating from the ABI instrument scanner **shall** be less than +/-0.8 Newton meters (+/-7 in-lb.)(TBR). The duration of the disturbances **shall** not exceed 0.1 seconds(TBR). Smaller torques may be applied for proportionally longer periods of time. The torques represent net torque transmitted to the spacecraft by motors less any bearing and flexible wire assembly drags or torsions internal to the instrument that the motors work against. A second, partly compensating, torque of opposite sign may be applied after the each torque pulse if required. There may be some small residual unbalanced torque for up to 20 seconds as, for example, a scan mirror slews to a new location. These torques are defined at and delivered to the spacecraft via the instrument mounting surface.

3.2.4.3 Uncompensated Momentum

The instrument **shall** have a maximum continuous uncompensated momentum of 0.81 Newton-meters-seconds (0.6 ft-lb-sec) (TBR) allowed in the S/C pitch axis (Y-axis) and 0.081 Newton-meter-seconds (0.06 ft-lb-sec) (TBR) in the S/C roll and yaw axes. The 0.081 Newton-meter-seconds (0.06 ft-lb-sec) allows for misalignment of the instrument momentum vector relative to the S/C yaw and roll axes. The corresponding X,Y and Z instrument axis and spacecraft axis are parallel to each other.

3.2.4.4 Mechanical Handling

The instrument contractor **shall** provide specific lifting points on the instrument, which **shall** allow handling with an overhead crane. A minimum of three lifting points **shall** be provided that allows the mounting surface to be in a horizontal attitude during installation.

3.2.4.4.1 Handling Fixtures

The instrument contractor **shall** provide proof tested handling fixtures for each instrument and module weighing in excess of 16 kg (35 lbs).

Handling fixtures **shall** be designed to 5 times limit load for ultimate and 3 times limit load for yield. Handling fixtures **shall** be tested to 2 times working load.

3.2.5 Instrument and Module Structural Dynamics

3.2.5.1 Minimum Fixed-Base Frequency

Each separately mounted instrument and module, configured for launch, **shall** have a fixed base frequency of ? 50 Hz. Fixed base is defined as follows: Each mounting point **shall** be constrained in those degrees of freedom which are rigidly attached to the spacecraft, and **shall** be free in those degrees-of-freedom for which kinematic mounts or flexures provide flexibility.

3.2.5.2 Low Mass Component Fixed-Base Minimum Frequency

Each separately mounted instrument and module with a mass of less than 22.7 kg (50 lbs) **shall** have a fixed-base frequency of ? 100 Hz.

3.2.6 Interface Design Limit Loads Requirements

3.2.6.1 Limit Loads Application

Limit loads **shall** be applied at the center of mass (CM) of the instrument or module, configured for launch, to design the mounting interface.

3.2.6.2 Limit Loads Application Axis

The loads **shall** be applied in one direction in such a way as to produce the maximum stresses at the interfaces.

3.2.6.3 Interface Limit Loads

The limit loads **shall** be based on the mass of the instrument or module as defined in Figure 3.2.6.3-1

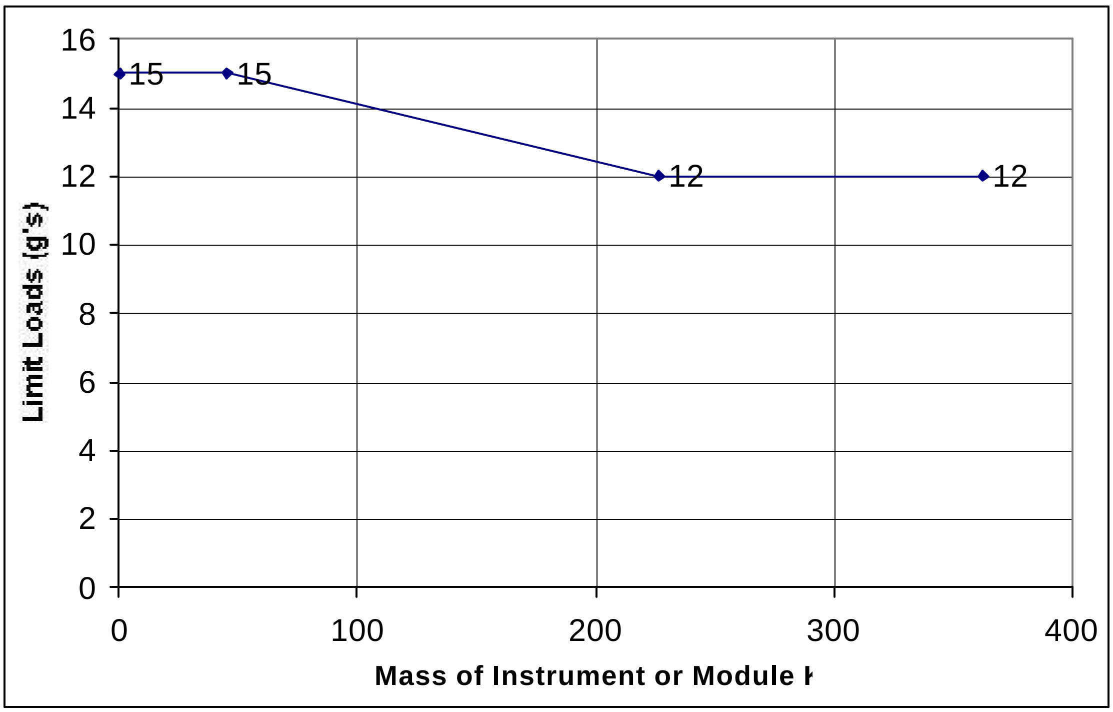


Figure 3.2.6.3-1 - Design Limit Load vs. Instrument and Module Mass

3.2.6.3.1 Design Limit Loads

The design limit loads **shall** be multiplied be a factor of 1.4 to obtain the ultimate design loads, and by 1.25 to obtain the yield design loads.

3.2.6.3.2 Qualification Loads

The verification limit loads derived from the final coupled loads analysis **shall** be multiplied by a factor of 1.25 to obtain qualification test loads.

3.2.7 Instrument Mechanisms

All instrument mechanisms which require restraint during launch **shall** be caged during launch without requiring power to maintain the caged condition.

3.2.7.1 Caging During Test and Launch

Instrument mechanisms which require caging and/or uncaging during test and launch site operations **shall** be capable of being uncaged by command and recaged by command or by manual actuation of accessible locking/unlocking devices.

3.3 Thermal

3.3.1 Allowable Temperatures

The ABI qualification, cold start, orbit raising and mission allowable temperatures are **TBD**. The spacecraft and ABI instrument design **shall** provide a thermal interface and mission design that maintains the ABI temperature as defined in the following cases:

?? Under all Geosynchronous orbit conditions, including on-orbit storage and safe hold within the mission allowable temperature range

?? During launch and orbit raising activities - above the orbit raising temperatures and below the acceptance high temperatures

?? For any ABI turn-on - above the cold start temperature limits

?? During spacecraft-level environmental testing - within the acceptance high/low temperature range.

3.3.2 Instrument Thermal Control Design

The ABI sensor module **shall** be thermally isolated from the sensor module's mounting surface and from other objects on the spacecraft (TBR) to the maximum feasible extent. The spacecraft **shall** be capable of accepting the heat from the electronics or power supply module (if used) and controlling the temperature of the mounting surface of the modules to qualification level temperatures between -20 and +55 C (TBR) for the electronics module and -20 to +60 C (TBR)for the power supply up to the power levels of Table 3.1.2-1. The nominal mission allowable mounting surface temperatures **shall** be -5 to +40 C (TBR) for both modules. The sensor module thermal design features **shall** be considered in the design of the spacecraft interface.

The mission allowable temperature range is that predicted and/or measured for orbital operation, with uncertainties over the life of the mission. The acceptance test range is 5 degrees C more extreme than the mission allowable temperature range to allow for production variability. The qualification test range (for the protoflight or first instrument) is 10 degrees C more extreme than the mission allowable temperature range. The cold start and orbit raising test temperatures are 10 degrees more extreme than the low qualification temperature for electronics and power supply modules and up to 7 degrees more extreme than the low qualification temperature of the sensor module.

3.4 Electrical

3.4.1. Grounding

Within the instrument, all electronic (power) returns consisting of pulse command returns, bilevel telemetry returns, instrument primary power return, and instrument secondary power returns **shall** be isolated from chassis (>100 k?) and from each other. Each of these returns **shall** receive their reference to chassis on the spacecraft side of the interface.

3.4.2 Test Connectors

Test points **shall** be provided by the instrument to facilitate testing and ensure conformance with the system specification.

A separate test connector **shall** provide the means to verify the instrument power input fuse integrity. All test points **shall** be internally buffered so that the instrument performance is not affected when monitoring. Short circuit protection of all test points **shall** be provided. The instrument **shall** operate within specification while a test point is shorted to ground.

The spacecraft **shall** provide access to the electronics module (if used by the ABI) test connectors while the instrument is mounted on the spacecraft. The spacecraft contractor **shall** provide the test cables necessary to access the electronic module test connectors while the instrument is mounted on the spacecraft. The spacecraft **shall** provide access to the wires from instrument mounted accelerometers and thermocouples. The accelerometer and thermocouple wires **shall** be removed or terminated at the conclusion of spacecraft testing.

All digital test connectors for the "Standard Interface" **shall** be either Ethernet or UART (RS-422).

3.4.3 Power

The spacecraft **shall** provide +28VDC (TBR) power to the ABI through a single instrument power connector. Multiple parallel cables and connector pins will bring the power and the power return to the spacecraft. Critical, redundant, pulse commands will be used to apply and remove the power within the instrument.

3.4.3.1 Instrument Power Consumption

The following sections specify the maximum power that the instrument **shall** draw from the spacecraft at BOL. The instrument's EOL power consumption **shall** not exceed the maximum BOL values by more than 5%.

3.4.3.2 Steady-State BOL Power

The maximum steady state BOL power draw(excluding scan transients) the instrument **shall** not exceed **TBD** Watts.

The instrument's cooler outgas and anticontamination heaters **shall** provide thermostatic and (ON-OFF) control and **shall** draw no more than TBD Watts.

3.4.3.3 Transient Currents

The peak currents produced on the instrument power input by the instrument **shall** not exceed **TBD** amperes. The transient currents values represent absolute bus currents with steady state current subtracted out, the AC portion of any transient current **shall** be less than **TBD** amperes and **shall** have a rate of change of less than **TBD** amps per ?sec.

3.4.3.4 Average Power Draw While Scanning

For the ABI, the average power draw while scanning a normal observation sequence of a two full disk and six CONUS frames plus any required overhead in 30 minutes **shall** be less than **TBD** Watts. When CONUS coverage is replaced or augmented by 1000x1000km frames the average power **shall** be **TBD** Watts.

3.4.3.5 Power Dissipation of an Electronics and Power Supply Module (if used)

The maximum power dissipation for the electronics and power supply modules **shall** be **TBD** Watts and **TBD** Watts, respectively.

3.4.3.6 Fuses

Redundant, testable in place, easily replaceable, fuses **shall** be in the ABI.

3.4.4 Electromagnetic Compatibility

The spacecraft and instrument **shall** be designed for EMC using MIL-STD-1541 and MIL-STD-461-E as design guides. Conformance to EMC requirements **shall** be verified on flight unit, except when noted otherwise, using MIL-STD-462-E as a guide.

3.4.4.1 Steady-State CE of Power Line

TBS

3.4.4.2 Selected Signal Lines Conducted Emissions

TBS

3.4.4.3 Steady-State CS of Power Line

TBS

3.4.4.4 CS of Selected Signal Lines

TBS

3.4.4.5 Common Mode Voltage Noise

The maximum spacecraft generated common mode noise between chassis and instrument secondary return as measured at the instrument interface **should** not exceed the levels specified in Table 3.4.4-1 (**TBR)** when measured with the instrument in the flight grounding configuration.

Table 3.4.4-1 Common Mode Voltage Noise

Band	Measurement Method	Frequency Range	Maximum Level
Broadband	Oscilloscope (Bandwidth = 400 MHz)	Up to 400 MHz	0.5V peak-to-peak

3.4.4.6 Radiated Emissions of Instrument - Example from GOES-N Imager and Instrument of Opportunity ICD

The instrument's maximum Radiated Emissions, frequency ranges, and measurement bandwidth specifications **shall** be as shown in Table 3.4.4-2(**TBR)**. The radiated emissions from the instrument are specified at a distance of 1 meter from the sensor module's optical port while the instrument is operating. The spacecraft carries two very sensitive receiving systems operating in the 400 MHz region, Search and Rescue and Data Collection System, which require the very low emissions in that region. Unintentional radiated narrowband electric field levels produced by Instrument **shall** have a level in a 100 Hz resolution bandwidth from 401.7 MHz to 402.4 MHz, and 406 MHz to 406.1 MHz, for a dipole antenna placed 1 meter from the Instrument under test, in accordance with test method RE02 of MIL-STD-461-E, that is not greater than the levels shown in Table 3.4.4-2. The specific frequencies and power levels in tables 3.4.4-2 and 3.4.4-3 are **TBR** and will not be fully refined until the new spacecraft communication systems are designed.

Table 3.4.4-2 Radiated Emissions of Instrument

(all values are TBR)

Frequency Range		Maximum Measurement Bandwidth	Field Strength, dB?V/m
Lower Frequency	Upper Frequency		
14 kHz	2.4 MHz	1 kHz	54
2.4 MHz	30 MHz	10 kHz	60
30 MHz	200 MHz	100 kHz	76
200 MHz	1 GHz	100 kHz	62
1 GHz	10 GHz	1 MHz	72
401.700 MHz	402.400 MHz	100 Hz	–10
406.000 MHz	406.100 MHz	100 Hz	–13
2025.600 MHz	2029.800 MHz	100 Hz	0
2032.950 MHz	2033.050 MHz	100 Hz	0
2034.150 MHz	2034.250 MHz	100 Hz	0
2034.850 MHz	2034.950 MHz	100 Hz	0

3.4.4.7 Radiated Susceptibility of Instrument - Example from GOES-N Imager ICD

The spacecraft **shall** not produce radiated interference levels (**TBR)** in excess of the radiated susceptibility (RS) of the instrument as defined in Table 3.4.4-3. The requirement applies at the frequencies (**TBR**) shown in Table 3.4.4-3 at two source positions, using a MIL-STD-461E, RS103 test method setup:

1) The source positioned 1 meter from the sensor module’s optical port.

2) The source positioned 1 meter from the sensor module’s radiant cooler.

The RS requirement is satisfied if the noise increase is such that the NEDT, SNR, and pointing accuracy requirements would still be met.

Table 3.4.4-3 RS Test Frequencies and Field Strengths
All Test Frequencies and Field Strengths are TBR

Function	Frequency, MHz	Field Strength (50% Modulated with 1khz signal), V/m
DCPI Repeater	468.800	0.6
SAR Repeater	1544.500	1.0
Instrument Data	1676.000	1.0
MDL Data	1681.480	1.0
PDR Repeater	1685.700	1.0
WEFAX Repeater	1691.000	1.0
CDA Telemetry	1694.000	1.0
DCS Pilot Report	1694.450	1.0
DCPR Repeater (Domestic)	1694.500	1.0
DCPR Repeater (International)	1694.800	1.0
Telemetry DSN	2208.586	1.0
Telemetry DSN	2209.086	1.0

3.4.4.8 Electrostatic Arc-Discharge Susceptibility

The spacecraft **shall** be designed to minimize the occurrence of ESD events on the instrument and **shall** not allow discharges greater than the maximum specified for the instrument.

The instrument **shall** be designed to withstand both a radiated and direct arc as shown in Table 3.4.4-4 without sustaining permanent damage. The direct arc-discharge can occur on any of the exposed surfaces of the instrument. Instrument operation **shall** not be impaired after the arc discharge

Table 3.4.4-4 ESDS Characteristics

Item	Description	Characteristics
1	Discharge Voltage	10 kV
2	Discharge Energy	3 millijoules maximum
3	Peak Current	1 Amp
4	Time Constant	600 nsec
5	Repetition Rate	1 sec
6	Quantity of Discharges per Surface	?30
7	Distance of Radiated Discharge from Instrument Surface	30 cm

3.5 Standard Interfaces

This section describes the electrical interface standards for the ABI. Currently, only placeholder interface standards are described to illustrate the types of requirements that will be levied after true interface standards are adopted. These placeholder requirements do not represent a preference by the government, but only a first guess at what might be appropriate standard interfaces. Consequently, all mandatory (i.e., shall) and goal (i.e., should) requirements within the subsections of Section 3.5 are non-binding at this time. Development of actual standard interface requirements will occur after the government reviews the results of the ABI trade studies on implementing standard interfaces and open architecture.

3.5.1 Standard Interface Requirements

The ABI **shall** provide a minimum of two (2) standard data interfaces: One for the exchange of commands, engineering data, spacecraft measured instrument mounting surface angular motion and spacecraft attitude data and a second for the downlink of ABI instrument data and ancillary data. In addition, interfaces **shall** be provided for the monitoring of critical analog instrumentation such as thermistor data and initiating control of the instrument. Standard ground support interfaces principally used for the loading/dumping of any ABI processor memory are included. Figure 3.5-1 shows the proposed standard interfaces.

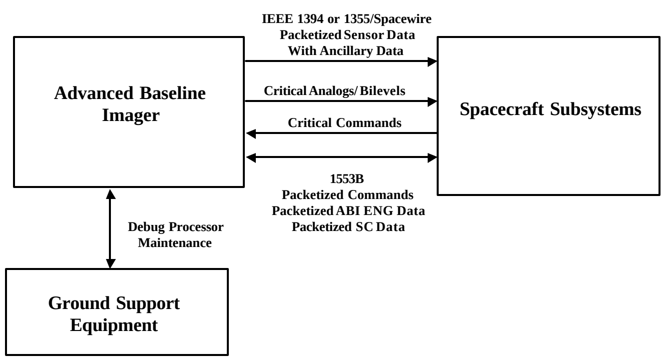


Figure 3.5-1 Proposed ABI Standard Interfaces

3.5 1.1 Standard High Speed Interface for Instrument Data

Redundant IEEE 1394 or IEEE 1355 (as amended by Issue E of ECSS-E-50-12) interfaces **shall** be used for the transmission of all formatted ABI imagery and ancillary data for downlink and/or recording by the spacecraft.

3.5.1.1.1 Maximum Aggregate Data Downlink Rate

The maximum aggregate data rate of all ABI formatted downlink data, including any spacecraft provided ancillary data **shall** not exceed an average rate as defined in the PORD at a burst rate of 100 Mb/s (TBR) on the high speed bus. The average data rates include the CCSDS packet overhead.

3.5.1.1.2 High Speed Data Packetization and Data Content

The ABI **shall** format all instrument data into CCSDS source packets. The ABI instrument **shall** format any spacecraft provided housekeeping data, attitude data and instrument mounting surface angular motion data into CCSDS packets. The data stream **shall** contain sufficient ABI information to fully process the ABI image.

3.5.1.1.3 IEEE 1394 or IEEE 1355/Spacewire Bus Characteristics

The high speed bus **shall** conform to the IEEE 1394-1995 specification or IEEE 1355-1995 specification (as amended by Issue E of ECSS-E-50-12) Extensions to the standard **shall** be minimized. Deviations and extensions to the standard **shall** be fully documented in the ABI – spacecraft ICD.

3.5.1.1.3.1 Node Address

The ABI **shall** use one (1) IEEE-1394 or IEEE 1355/Spacewire node address for the currently active bus. The IEEE-1394 or IEEE 1355/Spacewire node electronics **shall** be part of the instrument.

3.5.1.1.3.2 Spacecraft Acts as Bus Controller

If the IEEE 1394 bus is selected, the spacecraft **shall** act as the bus master with the ABI acting as a bus slave.

3.5.1.1.3.3 IEEE 1394 Medium

If the IEEE 1394 bus is selected, the cable medium option of the IEEE 1394 **shall** be used. The connector type, wire type and pin assignment **shall** be specified by the vendor and documented in the ABI-spacecraft ICD.

3.5.1.1.3.4 Mode of Data Transfer

If the IEEE 1394 bus is selected, the ABI **shall** utilize the asynchronous IEEE 1394 data transfer mode.

3.5.1.1.3.5 High Speed Data Buffering Due To Bus Timing

The ABI **shall** provide sufficient internal buffering to accommodate a maximum of **TBD** msecs delay in the data transfer caused by the bus controller and bus flow control protocol.

3.5.1.1.3.6 Redundancy

Redundant buses **shall** be provided. Selection of the active bus **shall** be by command received by the ABI instrument over the command and telemetry bus.

3.5.1.1.3.7 Fault Tolerance

No single failure on the ABI high speed bus electrical interface or the spacecraft side of the interface **shall** prevent the ABI from communicating with the spacecraft over at least one of the two redundant high speed buses.

3.5.1.2 Standard Interface for Command and Telemetry

Dual Redundant MIL-STD 1553B interfaces **shall** be provided for the receipt of CCSDS packetized instrument commands, time code messages and to provide CCSDS packetized instrument engineering data such as housekeeping information, status and processor dumps and any other data for inclusion in the real time spacecraft telemetry stream. The command and telemetry interface **shall** be used for the transfer of spacecraft attitude information, instrument angular motion and other spacecraft ancillary information for inclusion in the high speed instrument downlink data.

3.5.1.2.1 Spacecraft Acts As Bus Controller

The spacecraft **shall** be the bus controller for all transactions on the command and telemetry bus.

3.5.1.2.2 Remote Terminal Address

The ABI instrument **shall** utilize one (1) 1553B RT address . The RT circuitry **shall** be part of the instrument.

3.5.1.2.3 Selection of the Active Command and Telemetry Bus

Upon initial power up of the ABI instrument, the ABI **shall** use command and telemetry bus 1 as the active bus. Switching between the inactive and active command and telemetry buses **shall** be performed upon receipt of a critical command from the spacecraft (**TBR)**.

3.5.1.2.4 Data Retransmission

In the event of an error in the transmission of data or command packets between the ABI instrument and the spacecraft, the Bus Controller **shall** retry on the active side n times (**TBD**). A ground command will be used to switch to the other side of the bus if required to clear the fault condition (**TBD)**.

3.5.1.2.5 Data Buffering

The instrument **shall** provide internal buffering to store 2 CCSDS packets or 2 seconds of data, which ever is more (**TBR)**.

3.5.1.2.6 Instrument Modes and Engineering Data Rates

The data bandwidth allocated to the ABI instrument over the standard command and telemetry bus is a function of instrument and/or spacecraft operating mode. The allocation is **TBD**.

3.5.1.2.7 ABI Housekeeping Telemetry

ABI instrument telemetry is divided into "Critical" telemetry and "Non-Critical" telemetry. Critical telemetry is that instrument related data such as temperature data, power status and pyrotechnic device status that needs to be sampled by the spacecraft even if the instrument is unpowered in order to determine its safety. "Non-Critical" telemetry is that data that is not required to be sampled unless the instrument is powered with the standard bus active.

3.5.1.2.7.1 ABI "Non-Critical" Telemetry

All non-critical ABI instrument engineering data **shall** be formatted in CCSDS packets and relayed to the spacecraft over the standard bus. The packet structure **shall** include a method for detecting any bus transmission errors if the standard bus does not provide such a feature.

3.5.1.2.7.2 ABI "Critical" Telemetry

Critical telemetry will be sampled and formatted by the spacecraft into it's PCM housekeeping telemetry. The instrument **shall** provide **TBD** passive analog channels, **TBD** bilevel channels and **TBD** active analog channels. The interface used for the sampling of critical telemetry **shall** be either a **TBD** low speed/low power bus which is always powered or point-to-point interfaces. All critical telemetry interfaces **shall** be redundant **(TBR).** The characteristics of these channels are **TBD.**

3.5.1.2.7.3 ABI Housekeeping Data Content

The ABI Housekeeping data content **shall** include all data necessary to monitor instrument health, to determine its status and diagnose anomalous conditions. This data **shall** include but not be limited to:

?? Instrument mode and configuration
?? Instrument temperatures
?? Instrument power supply current and voltages
?? Relay status, scan mirror status and other rotating mechanism rates
?? Processor mode/status information

In addition, the ABI instrument **shall** have commandable modes which affect the selection of the data for downlink. For instance, the ABI **shall** include a dwell capability. Upon receipt of a dwell command which specifies the telemetry item, the ABI **shall** sample the specified data item at a rate of up to 10 samples/second if the formatting is defined by the ABI.

3.5.1.2.8 ABI Instrument Commands

ABI commands are divided into "Critical" and "Non critical" commands. Critical commands are those commands that are necessary to configure the instrument when it is off, reset instrument operation when it is not responding to commands over the standard command, command and telemetry bus selection and commands to pyrotechnic devices. "Non critical" commands are those commands that are normally issued over the standard bus such us configuration changes, memory loads, etc.

3.5.1.2.8.1 ABI "Non-critical" Commands

All ABI commands issued over the standard bus **shall** be formatted as CCSDS command packets. The command packet structure **shall** include a method for detecting any bus transmission errors if the standard bus does not provide such a feature.

3.5.1.2.8.2 ABI "Critical" Commands

All ABI critical commands **shall** utilize redundant dedicated command interfaces (**TBR)**. The critical command interface **shall** be either a **TBD** low speed/low power bus which is always powered or point-to-point interfaces. Potentially hazardous commands, such as pyrotechnic commands, **shall** require separate enable and execute commands. The enabled function **shall** be disabled by the ABI instrument or the spacecraft after **TBD** seconds. The electrical characteristics of the command interface are **TBD.**

3.5.1.2.9 Spacecraft Attitude and Housekeeping Data

The ABI instrument **shall** ingest Spacecraft Motion Compensation (SMC) attitude information, instrument mounting surface Angular Displacement Sensor (ADS) data and spacecraft housekeeping information formatted as CCSDS packets over the Command and Telemetry interface. The maximum aggregate rate of this data is 50 Kb/s (**TBD**) that must be included in the instrument data to the spacecraft. The frequency of the occurrence of this data is **TBD.** The SMC is updated about 30 times per second and describes the motion of the ABI mounting surface from "DC" to about 3Hz with a dynamic range of 400 urad and an uncertainty of about 4 urad. All values are TBD. The ADS data is updated about 1000 times per second and describes the motion of the ABI mounting surface from about 3Hz to 250 Hz with a dynamic range of 100 urad and an uncertainty of abut 2 urad. All values are TBD. The SMC and ADS provide data about the motion in all 3 axis.

3.5.1.2.10 Time Code Data and Synchronization

The spacecraft **shall** provide time code data using CCSDS formatted packets over the standard command and telemetry bus. The format of the time code words **shall** be based on universal time coordinated (UTC) and conform to one of the CCSDS time code standards. The time code message **shall** be transmitted once per second. Absolute time correlation **shall** be 1 millisecond with 1 microsecond as a goal. The method of synchronizing the time code message to a “time mark” is **TBD.**

3.5.1.2.11 Fault Tolerance

No single failure on the ABI side of the command and telemetry electrical interface or the spacecraft side of the interface **shall** prevent communication over at least one of the two redundant buses.

3.5.1.2.12 Scan Status

The instrument **shall** provide information on scan status to the spacecraft over the standard buss formatted into CCSDS packets. Scan status information will include, but not be limited to: Scan Active, Star data acquisition, Slew in process, Black Body calibration in process, etc.

3.5.1.3 Ground Support Equipment Interfaces

The ABI **shall** provide ground support equipment (GSE) interfaces that are intended to be used during “off the spacecraft” testing. The primary use of this interface is to provide an alternate way to interrogate, load and control the operation of any ABI embedded flight processor. The GSE interfaces **shall** be commercially available and use a commercial protocol. Acceptable interfaces include TCP/IP over Ethernet and UART RS-422.

3.5.3 Operations Database Requirements

The Satellite System Engineering Database (SSED) **shall** include the flight telemetry and command database requirements for the ABI.

3.6 Contamination Control - Spacecraft Contractor

The spacecraft contractor **shall** comply with the **TBD** requirements to minimize contamination from the spacecraft and integration and testing activities degrading the optical and thermal surfaces of the ABI .

3.6.1 Ground Processing

3.6.1.1 Spacecraft Contractor Facility Requirements (TBR)

The instruments **shall** be processed in a Class M6.5 (100,000) cleanroom (at 0.5 µm and 5.0 µm per Fed-Std 209). Airborne particle counts **shall** be taken at least once per week during Class M6.5 (100,000) operations. During operations that require exposure of contamination sensitive optical or thermal surfaces, the instruments **shall** be maintained in a Class M5.5 (10,000) cleanroom (at 0.5 µm and 5.0 µm per Fed-Std-209). The functional goal **shall** be Class M4.5 (1000) in actual practice. Airborne particle counts **shall** be taken at least once per hour during Class 10,000 operations. The instruments **shall** be maintained in relative humidity environment between 30 and 60%.

3.6.1.2 Equipment Requirements

Spacecraft test and ground support equipment **shall** be designed to preclude contamination of the instrument. Potential contamination sources such as thermal/vacuum targets and insulation blankets **shall** be vacuum baked prior to use with the instrument.

3.6.1.3 Purge Requirements

The spacecraft contractor **shall** provide a gas purge to the instrument optical cavity during all operations at the spacecraft facility(s), launch site, and during transportation (prior to fairing encapsulation) and storage if required by the ABI.

3.6.1.4 Ground Storage Requirements

During storage and transportation periods, the instrument **shall** be bagged in ESD protective material. Witness samples representative of the instrument sensor module surface **shall** be examined and changed every six months during extended storage periods.

3.6.2 Spacecraft and Mission Considerations

3.6.2.1 Spacecraft and Mission Design Requirements

Multilayer insulation venting and spacecraft vents **shall** be directed away from the instrument optical port and radiant cooler. All spacecraft components (such as insulation blankets, harnesses, and painted surfaces) with the potential to contaminate the instrument optical and thermal surfaces **shall** be vacuum baked prior to thermal vacuum testing with the instrument.

Protective and/or preventative measures **shall** be taken to preclude particulate contamination of the optical cavity and radiant cooler during launch and orbit raising.

The effects of direct or reflected ultraviolet radiation on the contamination of the optical and thermal surfaces of the instrument **shall** be considered in the design of on-orbit operations including storage and safe hold modes.

3.6.2.2 Particulate Contamination

The spacecraft **shall** contribute no more than 0.02% **(TBR)** area particle coverage to the "virtual" surface of the instrument optical aperture. These requirements **shall** be interpreted as the total allowable end-of-life contribution from the spacecraft, launch vehicle, and spacecraft facility(s) to instrument contamination over the sum of all ground processing, launch, orbit raising, and mission activities.

3.6.2.3 Molecular Contamination

The spacecraft **shall** contribute no more than 1.0 mg/ft^2 (100 Å) **(TBR)** nonvolatile residue to the instrument radiant cooler, and the "virtual" surface of the instrument optical aperture. This requirement **shall** be interpreted as the total allowable end-of-life contribution from the spacecraft, launch vehicle, and spacecraft facility(s) to instrument contamination over the sum of all ground processing, launch, orbit raising, and mission activities. This requirement **shall** include contamination from all sources including spacecraft outgassing and plume impingement.

3.6.2.4 Prelaunch Cleaning Access

Several areas of the ABI sensor module may require special access for cleaning. Although the sensor module is manufactured in a manner to minimize the accumulation of contamination, cleaning of the sensitive surfaces may still be required to maximize performance. The instrument spacecraft and ground handling equipment **shall** be designed to allow access to the following areas until the final preparation-for-launch closeout:

1) Optical port cavity for cleaning of the accessible telescope mirrors, scan mirror, and the optical cavity surface
2) The optical solar reflector (OSR) surfaces, if used.

3.7 Shielding Radiation Environment

The instrument **shall** be designed to survive ionization and displacement damage produced by the expected space radiation environment as defined in the Performance and Operation Requirements Document during its mission life (TBD).

3.8 Magnetic Field Emissions

The change in the magnetic field produced by the instrument, electronics, or power supply modules, **shall** be less than 30 nanoTesla peak-to-peak, for any instrument operating mode, up to a single-pole lowpass bandwidth of 1.0 Hz, in any axis when measured at a distance of 1 meter from any face of the modules. The GOES spacecraft carries a very sensitive magnetometer.

3.9 Launch Environments

3.9.1 Thermal

The thermal environment during launch is **TBS**.

3.9.2 Barometric Pressure

The instrument **shall** be designed for an environment that is between 1 x 10^{-10} mm Hg (Torr) and 815 mm Hg. The maximum barometric pressure increase **shall** be 14 mm Hg/sec, and the maximum barometric pressure decrease **shall** be 57 mm Hg/sec. For the maximum decrease in barometric pressure, there **shall** be a 2X design margin as shown by analysis. If a 2X margin cannot be shown by analysis, a test **shall** be performed. The pressure decrease rate used in the test **shall** be 1.12 times the maximum rate.

3.9.3 Mechanical Environments

3.9.3.1 Random Vibration

Table 3.9.3.1.1 and Table 3.9.3.1.2 provide the protoflight and prototype qualification random vibration levels to which the instruments and components **shall** be exposed during testing. Protoflight test duration **shall** be 1 minute for each axis. Prototype qualification test duration **shall** be 2 minutes for each axis. Acceptance test levels are 3 dB less than those shown in Table 3.9.3.1.1 with a duration of 1 minute for each axis. At no time **shall** any instrument or component be tested to levels less than the minimum workmanship levels specified in Table 3.9.3.1.2.

Table 3.9.3.1.1. Random Vibration Test Levels

Protoflight Vibration Test Levels	
Frequency (Hz)	ASD (g^2/Hz)
20 20-50 50-800 800-2000 2000	0.026 +6dB/oct 0.16 -6dB/oct 0.026
Overall	14.1 G_{rms}

The acceleration Spectral Density level may be reduced for components weighing more than 22.7-kg (50 lb) according to:

	Weight in kg	**Weight in lb**
dB reduction	10 log(W/22.7)	10 log(W/50)
ASD $_{(50\text{-}800\ \mathrm{Hz})}$	0.16(22.7/W)	0.16(50/W)

Where W = component weight.

The slopes **shall** be maintained at + and –6dB/oct for components weighing up to 59 kg (130 lb). Above that weight, the slopes **shall** be adjusted to maintain an ASD level of 0.01g2/Hz at 20 and 2000 Hz.

For components weighing over 182 kg (400-lb), the test specification will be maintained at the level for 182 kg (400 lbs).

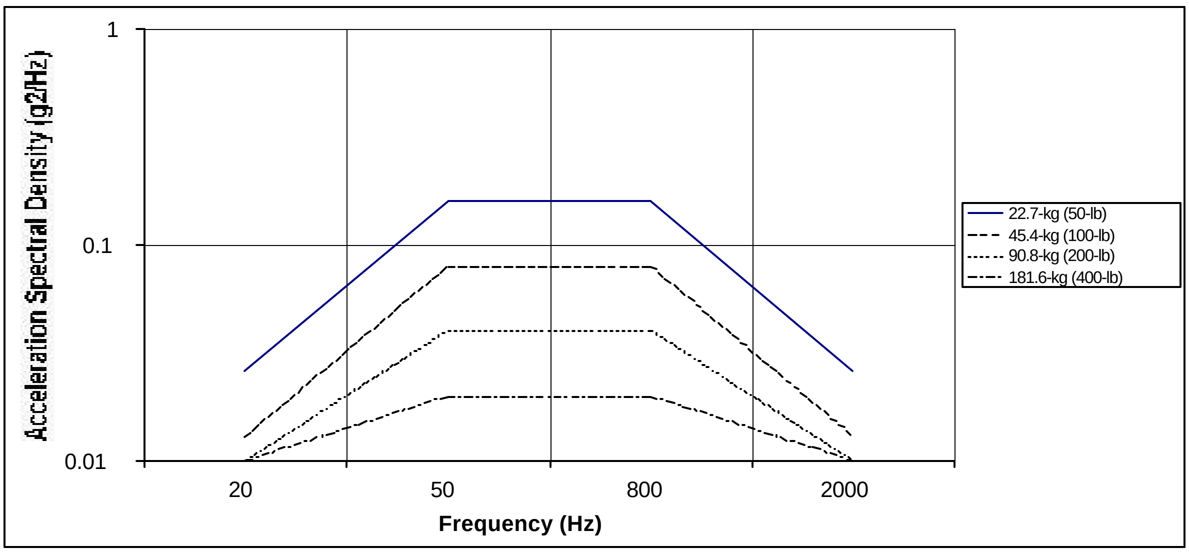


Table 3.9.3.1.2. Random Vibration Workmanship Test Levels

Minimum Workmanship Vibration Test Levels	
Frequency (Hz)	ASD (g^2/Hz)
20	0.01
20-80	+3dB/oct
80-500	0.04
500-2000	-3dB/oct
2000	0.01
Overall	6.8 G_{rms}

The plateau acceleration spectral density level (ASD) may be reduced for components weighing between 45.4 and 182 kg, or 100 and 400 pounds according to the component weight (W) up to a maximum of 6 dB as follows:

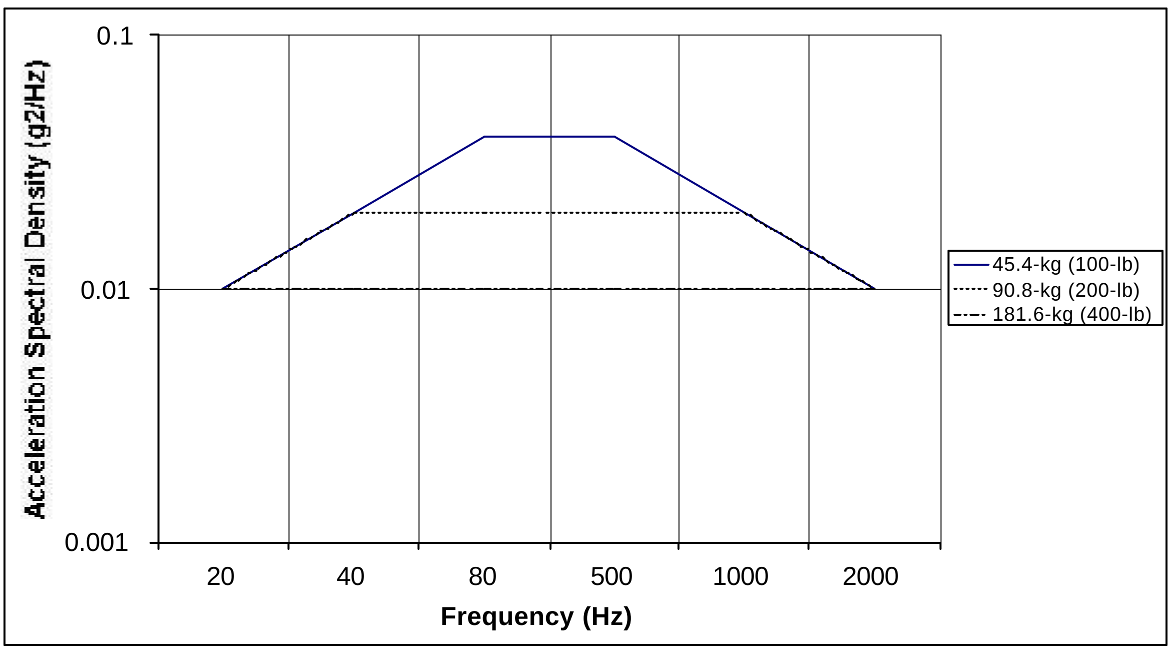
	Weight in kg	**Weight in lb**
dB reduction	10 log(W/45.4)	10 log(W/100)
ASD $_{(plateau)}$ level	0.04(45.4/W)	0.04(100/W)

The sloped portions of the spectrum **shall** be maintained at + and –3dB/oct.Therefore, the lower and upper break points, or frequencies at the ends of the plateau become:

F_L =80 (45.4/W) [kg] F_L = frequency break point low end of plateau
=80 (100/W) [lb]

F_H =500 (W/45.4) [kg] F_H = frequency break point high end of plateau
=500 (W/100) [lb]

The test spectrum **shall** not go below 0.01G^2/Hz. For components whose weight is greater than 182 kg or 400 pounds, the workmanship test spectrum is 0.01 G^2/Hz from 20 to 2000 Hz with an overall level of 4.4 G_{rms}.



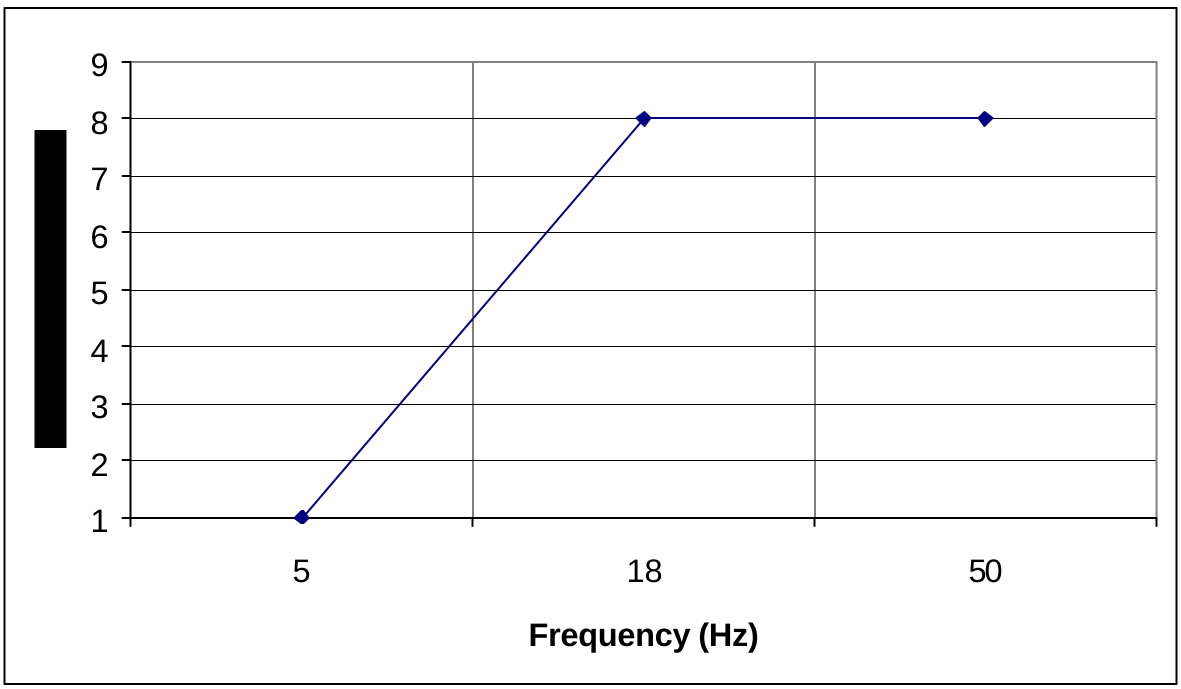
3.9.3.2 Sine Vibration

The instrument or component **shall** be subjected to protoflight/qualification sine vibration test levels specified in Table 3.9.3.2.1 in each of three orthogonal axes. During this test the instrument or component **shall** be in the launch configuration. There **shall** be one sweep from 5 Hz to 50 Hz for each axis. The protoflight sweep rate **shall** be 4 oct/min. For prototype qualification testing, the sine vibration levels **shall** be the same as protoflight levels but with the sweep rate reduced by a factor of 2 to 2 oct/min.

Some type of response limiting would be allowed whether it be notching or force limiting.

Table 3.9.3.2.1 Sinusoidal Protoflight Test Levels

Frequency	Amplitude/Acceleration
5 - 18	Displacement = 12 mm (double amplitude)
18 – 50	8 G peak



3.9.3.3 Design Strength Qualification

The instrument or component **shall** be tested to a set of loads equal to 1.25 times the predicted loads from a coupled flight loads analysis. Acceleration testing, static load testing, or vibration testing may apply these loads.

3.9.3.4 Shock

The instrument or component **shall** be designed to meet performance requirements following exposure to the shock environment specified in Figure 3.9.3.4.1 for a time less than 30 milliseconds (TBS). Instrument or component **shall** be designed to survive a peak of 1200 G's without permanent performance degradation. This is the environment at the instrument interface, not the spacecraft/launch vehicle interface.

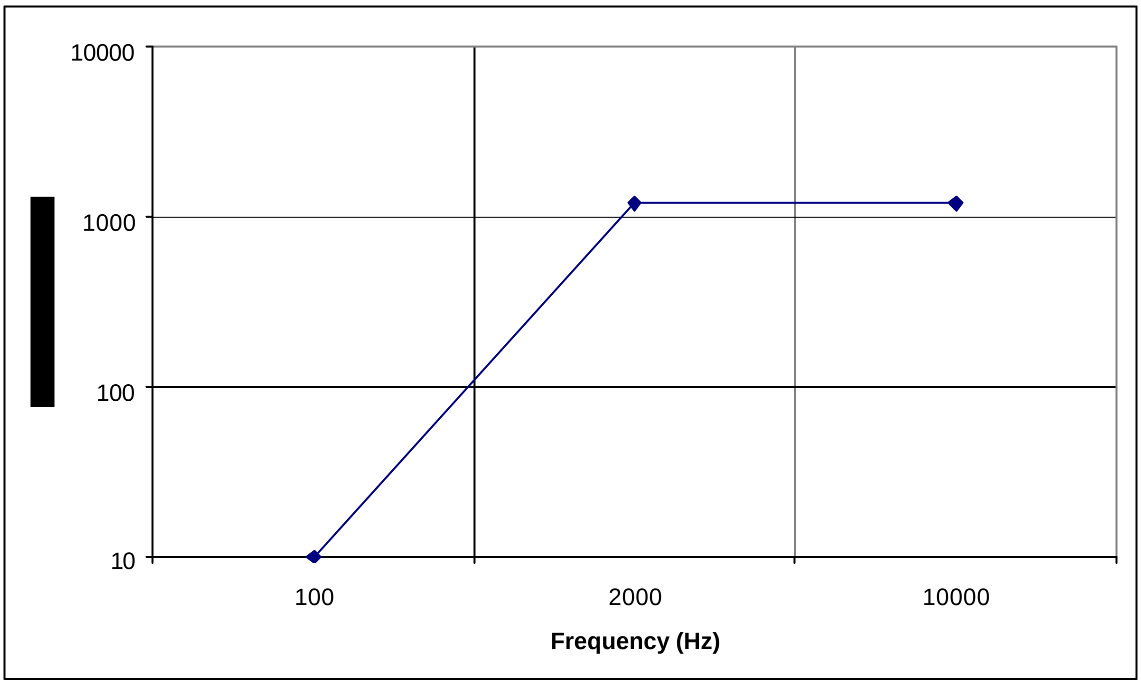


Figure 3.9.3.4.1. Shock Spectrum

3.9.3.5 Acoustics

The instrument or component **shall** be designed to survive the protoflight acoustic levels shown in Table 3.9.3.5-1. Acceptance acoustic levels are 3 dB less than protoflight as shown in Table 3.9.3.5-1. Test duration **shall** be 1 minute for acceptance and protoflight testing and 2 minutes for prototype qualification. Testing at the instrument level will be required only if there are elements in the ABI that may fail during the spacecraft acoustic test environment.

Table 3.9.3.5-1. GOES S/C Acoustic Environment

One-Third Octave Band Center Frequency, Hz	GOES Acceptance Level, dB*	GOES Protoflight Level, dB*	Test Tolerance, dB*
25	114	117	+3/-3
31.5	125.4	128.4	+3/-3
40	125.4	128.4	+3/-3
50	125.2	128.2	+3/-2
63	126.3	129.3	+3/-2
80	128	131	+3/-2
100	129.8	132.8	+3/-2
125	130	133	+3/-2
160	131.5	134.5	+3/-2
200	131.6	134.6	+3/-2
250	130.5	133.5	+3/-2
315	130	133	+3/-2
400	130.1	133.1	+3/-2
500	129.9	132.9	+3/-2
630	128.3	131.3	+3/-2
800	127	130	+3/-2
1000	124	127	+3/-2
1250	122	125	+3/-2
1600	120.5	123.5	+3/-2
2000	121.8	124.8	+3/-2
2500	118	121	+3/-2
3150	117.5	120.5	+3/-3
4000	115.5	118.5	+3/-3
5000	114.5	117.5	+3/-3
6300	113.8	116.8	+3/-3
8000	114	117	+3/-3
10000	114.8	117.8	+3/-3
Overall SPL, dB	141.2	144.2	± 1.5
Duration, sec	60	60	+10%/-0%

* Reference pressure = 20 ? Pa

** Max acoustic environment (LPF, without acoustic blankets), acceptance test levels, duration,

Protoflight test margin/duration from: Atlas Launch System Mission Planner's Guide, Rev 6, February 1997, Lockheed Martin CLS.

*** Max acoustic environment from: Delta III Max Acoustic Acceptance Levels Users Guide (GOES N-Q IRD 20 March 98) Acceptance Test Duration, Protoflight Test Margin/Duration from: Delta III Payload Planner's Guide, MDC 95H0137, April 1996, McDonnell Douglas Aerospace

4.0 Acronyms List

ABI	Advanced Baseline Imager
ABI-GS	ABI-Ground System
AC	Alternating Current
amp	Ampere
AOS	Advanced Orbiting Systems
ASD	Acceleration Spectral Density
BOL	Beginning of Life
BW	Bandwidth
C	Celcius/Centigrade
CCSDS	Consultative Committee for Space Data Systems
CDA	Command and Data Acquisition
CE	Conducted Emissions
cm	centimeter
CONUS	Continental United States
CS	Conducted Susceptibility
cyc	Cycle
dB	Decibel
dBm	Decibel referenced to 1 milliWatt
EED	Electroexplosive Device
EMC	Electromagnetic Compatibility
EOL	End of Life
ESD	Electrostatic Discharge
FOV	Field of View
GOES	Geostationary Operational Environmental Satellite
GSE	Ground Support Equipment
Hg	Mercury
Hz	Hertz
ICD	Interface Control Document
IEEE	Institute of Electrical and Electronic Engineers
IMC	Image Motion Compensation
in-lb	Inch Pounds
INR	Image Navigation and Registration
IRD	Interface Requirements Document
K	Kelvin
kg	Kilogram
km	Kilometer
k?	KiloOhm
kV	KiloVolt
lb	Pound
m	Meter
Mbps	Mega-bits-per-second
mG	Milli-G
mg	Milligram
mHz	MegaHertz
min	Minute

msec	Millisecond
mV	MilliVolt
mw	MilliWatt
NASA	National Aeronautics and Space Administration
NESDIS	National Environmental Satellite, Data, and Information Service
NPOESS	National Polar-orbiting Operational Environmental Satellite System
nsec	nanosecond
NOAA	National Oceanic and Atmospheric Administration
oct	octave
OSR	Optical Solar Reflector
PCM	Pulse Code Modulation
PORD	Performance and Operation Requirements Document
RFP	Request for Proposal
RMS	Root Mean Square
RS	Radiated Susceptibility
S/C	Spacecraft
SI	International System of Units
SMC	Spacecraft Motion Compensation
SOCC	Satellite Operations and Control Center
SSED	Satellite System Engineering Database
TBD	To Be Determined
TBR	To Be Reviewed
TBS	To Be Supplied
TCP/IP	Transmission Control Protocol/Internet Protocol
UART	Universal Asynchronous Receiver Transmitter
um	Micrometer
usec	Microsecond
UTC	Universal Time Coordinated
vdc	Volts Direct Current